CS 311 Data Structures and Algorithms, Fall 2024

In-Class Worksheet 2: The Master Theorem—Solutions

Worksheet distributed in class on Monday, October 7.

1. Algorithm *B* is given a list as input. It uses a Decrease and Conquer strategy. It splits its input in half (or nearly so), and makes a recursive call on one of the parts. It also does other work requiring linear time.

Use the Master Theorem to determine the order of Algorithm *B*. As a guide through this process, answer each of the following.

Get b & a from the above description: 2 nearly equal-sized parts, 1 recursive call.

b = 2; *a* = 1.

f(*n*) is the amount of other work. This is linear time: $\Theta(n)$, that is, $\Theta(n^1)$.

f(*n*) is $\Theta(n^d)$. *d* = 1.

$a = 1$. $b^d = 2^1 = 2$. So $a < b^d$.

Compare *a* and b^d. Circle one comparison operator: *a* (<) = > b^d.

"<" gives case 1, "=" gives case 2, and ">" gives case 3.

Which case of the Master Theorem? Circle one: (1) 2 3

Case 1 of the Master Theorem says $\Theta(n^d)$. So $\Theta(n^1)$, that is, $\Theta(n)$: linear time.

Conclusion. The order of Algorithm *B* is (simplify!): $\Theta(n)$, or linear time.